



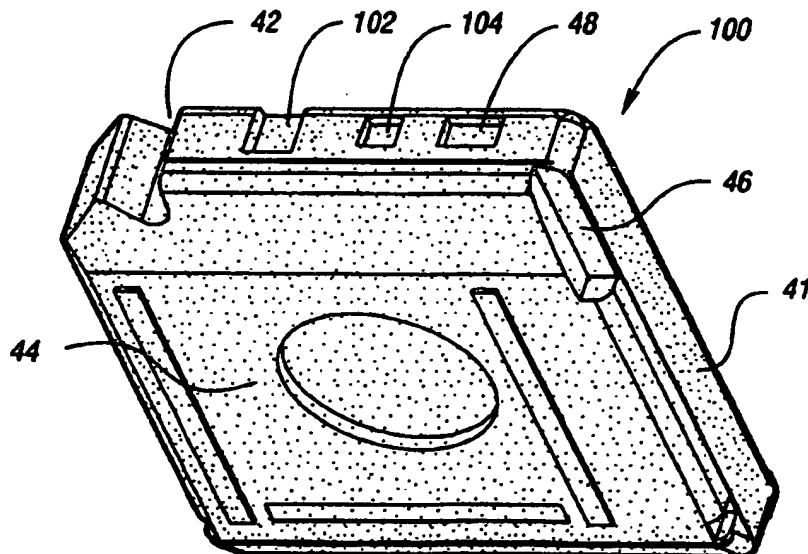
## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<p>(21) International Application Number: PCT/US99/07553</p> <p>(22) International Filing Date: 6 April 1999 (06.04.99)</p> <p>(30) Priority Data: 09/057,700 9 April 1998 (09.04.98) US</p> <p>(71) Applicant: STORAGE TECHNOLOGY CORPORATION [US/US]; 2270 South 88th Street, Louisville, CO 80028-4309 (US).</p> <p>(72) Inventors: OENES, Leon, C.; 7785 W. 106th Avenue, Bloom- field, CO 80021 (US). STEURY, Thomas, D.; 704 Rider Ridge Place, Longmont, CO 80501 (US). MORGAN, Philip, M.; 965 10th Street, Berthoud, CO 80513 (US). JOHNSON, Michael, Walter; 8470 Grange Boulevard, Cot- tage Grove, MN 55016 (US).</p> <p>(74) Agents: CHUEY, Mark, D. et al.; Brooks &amp; Kushman, 22nd floor, 1000 Town Center, Southfield, MI 48075 (US).</p>	<p>(81) Designated States: JP, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).</p> <p><b>Published</b> <i>With international search report.</i></p>	

(54) Title: TAPE CARTRIDGE

## (57) Abstract

A tape cartridge (100) for holding tape such as, for example, thin tape, that may be damaged by or cause damage to a standard tape deck (22). The cleaning notch (46) and present file protect notch (48) indicate that no tape is present when the cartridge (100) is inserted into a standard deck (22). A special fencing notch (102) indicates that a special cartridge (100) is present to a special tape deck. A special file protect feature (104) indicates whether the cartridge (100) is write protected or writable to a special tape deck. The special fencing notch (102) allows a sensor (122) in the special tape deck to also determine that the cartridge (100) is seated. The special file protect feature (104) may be implemented with a tab (188) that slides to set writeable or read-only modes.



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## TAPE CARTRIDGE

### Technical Field

5 The present invention relates to a tape cartridge that may be distinguished from a cartridge with the same shell format.

### Background Art

10 Tape systems allow large amounts of data to be stored in a cost effective manner. Tape systems include tape cartridges, which hold tape coated with a magnetic medium, and tape decks, which contain electronics capable of writing to and reading from the magnetic tape.

15 In order to prevent accidentally writing over saved data, many tape cartridges include a feature that allows the tape to be file protected. A sensor in the tape deck detects the file protect feature and will not allow data to be written to the tape.

20 Over time, heads in the tape deck responsible for writing to and reading from the tape become covered with contaminants. These contaminants may come from deterioration of the tape or from external dirt and debris. A cleaning cartridge can be inserted into the tape deck for cleaning the heads and other deck elements. In order to prevent attempts to write to or read from the cleaning cartridge, one or more features on  
25 each cartridge indicate whether the cartridge is for

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cleaning or for data storage. Corresponding sensors in the tape deck detects the cleaning cartridge feature and will not allow data access with a cleaning cartridge.

As tape technology improves, special designs  
5 such as, for example, thinner tape, are being developed. One difficulty with the new tapes is an increased possibility to crease, slit, or tear, destroying the tape and possibly damaging the tape deck. To avoid these problems, new drive mechanisms are being dev-  
10 eloped. However, the same basic tape cartridge format is used for standard and special tapes. What is needed is an ability to distinguish between standard and special tapes that prevents special tapes from being used on tape decks that do not have the proper drive  
15 mechanisms and that allows standard tapes to be used on tape decks with new mechanisms.

### **Summary Of The Invention**

It is an object of the present invention to enable a tape cartridge to prevent tape decks without  
20 the proper drive mechanisms from accessing the tape within the cartridge.

Another object of the present invention is to provide a method of distinguishing special cartridges from standard cartridges.

25 Still another object of the present invention is to provide a cartridge capable of indicating write protection for use with thin tape.

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A further object of the present invention is to provide a cartridge that can be identified as containing thin tape.

5 A still further object of the present invention is to permit recognition of a cartridge as a special cartridge and to detect that the cartridge is seated using a single sensor.

10 In carrying out the above objects and other objects and features of the present invention, a tape cartridge insertable into a tape deck is presented. The tape deck has an elevator for receiving the cartridge. The cartridge includes a shell having an end surface, the end surface having a tape slot from which tape may be drawn. A cleaning notch and a present file protect  
15 notch in the end surface indicate a standard tape quiescent state to a standard elevator, thereby causing control logic associated with the standard elevator to indicate that no tape is in the standard elevator. The cartridge also includes a special fencing notch in the  
20 end surface indicating to a special elevator that the cartridge is a special cartridge. The tape cartridge may further include a special file protect notch in the end surface indicating to the special elevator that the cartridge may only be read from.

25 In an embodiment, the tape cartridge has a tab attached to the edge surface in a manner allowing the tab to slide along the edge surface. The tab is positioned so as to cover the special file protect notch when slid into a first position and to expose the  
30 special file protect notch when slid into a second position.

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In another embodiment, the special fencing notch is located so as to further indicate to the special elevator that the cartridge is seated in the elevator.

5           The above objects and other objects, features, and advantages of the present invention are readily apparent from the following detailed description of the best mode for carrying out the invention when taken in connection with the accompanying drawings.

10                           **Brief Description Of The Drawings**

FIG. 1 is a diagram showing a top view of a "square tape" tape system;

FIG. 2 is a diagram of a tape cartridge prior to the present invention;

15           FIG. 3 is a diagram of a tape deck elevator prior to the present invention;

FIG. 4 is a diagram of a tape cartridge according to the present invention;

20           FIG. 5 is an edge view of the tape cartridge in FIG. 4.

FIG. 6 is a diagram of a tape deck elevator that may use the present invention;

25           FIG. 7 is a diagram of a switch assembly that detects when a feature is present and the cartridge is seated that may use the present invention;

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FIGS. 8A through 8C are sections illustrating the operation of the switch shown in FIG. 7; and

FIGS. 9A and 9B are edge views of an embodiment of the present invention illustrating a write protect tab.

### **Best Modes For Carrying Out The Invention**

Referring now to FIG. 1, a diagram of a "square tape" tape system is shown. A tape system, shown generally by 20, includes a tape deck, shown generally by 22, and tape cartridge 24. Tape deck 22 uses motherboard 26 to hold logic cardcage 28 and transport 30. Logic cardcage 28 holds logic cards, not shown for clarity, for control and data manipulation. Transport 30 includes elevator 32, head area 34, and take up reel 36.

When tape cartridge 24 is inserted into elevator 32, sensors in elevator 32 measure features on tape cartridge 24 to determine the cartridge type, such as standard tape or cleaning, and file protect status. When a cartridge is recognized by the sensors, the elevator moves down and, if the cartridge contains tape, a leader block attached to the tape is towed through the head area and to the take up reel. Recording and playback with the tape can now occur.

Referring now to FIG. 2, a diagram of a tape cartridge prior to the present invention is shown. A standard "square tape" tape cartridge is shown generally by 40. Shell 41 forms a housing, protecting tape within

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cartridge 40. Tape is drawn out or fed into standard cartridge 40 through tape slot 42 in an end surface of shell 41. Hub opening 44 on the bottom of cartridge 40 contains a tooth mechanism that meshes with a hub in transport 30 to drive the tape.

Standard cartridge 40 may contain features to indicate the cartridge type and protect status. A first feature, cleaning notch 46, indicates a cleaning cartridge. If cleaning notch 46 is not present, cartridge 40 is a standard data tape cartridge and not a cleaning cartridge. A second feature, present file protect (FP) notch 48, indicates write protection. If present file protect notch 48 is in cartridge 40, cartridge 40 may only be read from. If the second feature is essentially flush with shell 41, tape from cartridge 40 may be read from or written to. The presence or absence of present file protect notch 48 may be implemented in several manners including a rotatable cylinder with a flat in a first position to indicate the presence of file protect notch 48 and a curved surface in a second position to indicate the absence of file protect notch 48. The cylinder may be rotated by hand to set the file protect to either writable or read only.

Referring now to FIG. 3, a diagram of a tape deck elevator prior to the present invention is shown. A standard elevator, shown generally by 60, is used in tape deck 22. Standard cartridge 40 is inserted into tape insertion slot 62. Once inserted, the state of features is determined by sensors. A first sensor, cartridge present (CP) sensor 64, detects the presence of cleaning notch 46. A second sensor, file protect sensor 66, detects the state of present file protect



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notch 48. A control logic, not shown for clarity, is connected to cartridge present sensor 64 and file protect sensor 66. The control logic can determine whether standard cartridge 40 is a cleaning cartridge, is a file protected standard tape cartridge, or is a writeable standard tape cartridge. A fourth possibility, standard cartridge quiescent state, indicates no cartridge is present. This state will occur if a cartridge having both cleaning notch 46 and present file protect notch 48 is inserted in standard elevator 60.

Referring now to FIG. 4, a diagram of a tape cartridge according to the present invention is shown. Shell 41 forms a housing, protecting tape within cartridge 100. Tape is drawn out or fed into special cartridge 100 through tape slot 42 in an end surface of shell 41. Hub opening 44 on the bottom of cartridge 100 contains a tooth mechanism that meshes with a hub in transport 30 to drive the tape.

Special tape cartridge 100 is used with special options such as, for example, thin tape. Thin tape requires special handling by tape deck 22 to prevent the tape from creasing, slitting, or tearing. Damage to the thin tape may not only cause loss of data, but may damage tape deck 22 as well. In order to prevent damage to thin tape and to tape deck 22 not designed to handle thin tape, standard cartridge 40, standard elevator 60, and standard control system 80 are modified. In order to minimize cost, it is desirable to have these modifications not affect motherboard 26.

To prevent special tape cartridge 100 from being used in tape system 22 with standard elevator 60,

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cleaning notch 46 and present file protect notch 48 are in shell 41. This indicates a quiescent state to standard elevator 60 and, hence, tape cartridge 100 will not load.

5                   Since cleaning notch 46 and present file protect notch 48 are used to signal quiescent state when special cartridge 100 is in standard elevator 60, cleaning notch 46 and present file protect notch 48 cannot be used to indicate special cartridge present and  
10                   special cartridge file protect. Two new features are required. A third feature, special fencing notch 102, indicates that cartridge 100 is a special cartridge. A fourth feature, special file protect notch 104, indicates write protection. If special file protect notch  
15                   104 is present in shell 41, cartridge 100 may only be read from. If special file protect notch 104 is not present in shell 41, cartridge 100 may be written to or read from.

                  Referring now to FIG. 5, an edge view of the  
20                   tape cartridge in FIG. 4 is shown. In a preferred embodiment, the third and fourth features of cartridge 100 have dimensions as described below. Special fencing notch 102 is a rectangular region on shell 41. Special fencing notch 102 has a width dimension A of 0.410  
25                   inches and is located dimension B of 2.260 inches from the side edge containing cleaning notch 46. Special fencing notch 102 has a height dimension C of 0.502 inches and is located dimension D a minimum of 0.319 and a maximum of 0.400 inches from the bottom edge contain-  
30                   ing cleaning notch 46. Dimensions C and D sum to 0.902. Special file protect notch 104 is a rectangular region on shell 41. Special file protect notch 104 has a width

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dimension E of 0.300 inches and is located dimension F of 1.444 inches from the side edge containing cleaning notch 46. Special file protect notch 104 has a height dimension G of 0.291 inches and is located dimension H a minimum of 0.319 and a maximum of 0.465 inches from the bottom edge containing cleaning notch 46. Dimensions G and H sum to 0.756. When either or both of special fencing notch 102 and special file protect notch 104 are present, the indentation extends 0.175 inches into cartridge 100. All dimensions have a tolerance of  $\pm 0.010$  inches.

Referring now to FIG. 6, a diagram of a tape deck elevator that may use the present invention is shown. A special elevator, shown generally by 120, has a tape insertion slot 62 for accepting cartridge 40 or cartridge 100. Once in place, cartridge present sensor 64 and file protect sensor 66 determine the presence or absence of cartridge present cleaning notch 46 and present file protect notch 48 respectively. If cartridge 40 is either a standard cartridge or a cleaning cartridge, the output of cartridge present sensor 64 and file protect sensor 66 have the same meaning as described with regards to FIGS. 3 and 4 above. If the inserted cartridge is special cartridge 100, cartridge present sensor 64 and file protect sensor 66 indicate the standard cartridge quiescent state and additional sensors are required. A third sensor, second cartridge present sensor 122, detects the presence of special fencing notch 102. A fourth sensor, second file protect sensor 124, detects the presence of special file protect notch 104.

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In an embodiment of the present invention, low asserting switches are used to implement first cartridge present sensor 64, first file protect sensor 66, second cartridge present sensor 122, and second file protect sensor 124. In particular, each switch is an inverted open-collector with a 1,000 ohm pull-up resistor.

Referring now to FIG. 7, a diagram of a switch assembly that asserts when a feature is present and the cartridge is seated is shown. A difficulty exists in distinguishing between the case when a cartridge with a notch is seated in elevator 32 and the case when no cartridge is seated, since both cases may register the same with a typical sensor. The problem is solved using a switch with three positions as described below.

Second cartridge present sensor, shown generally by 122, includes linkage 140 and position sensor 144. Linkage 140 is coupled to the remainder of elevator 32 by a means allowing linkage 140 to move relative to elevator 32. In the preferred embodiment, the means is axle 142, shown hidden in FIG. 7. Axle 142 is steel and linkage 140 is an engineering polymer. Axle 142 will be more fully described with regards to FIGS. 8A through 8C below. Other means include spurs molded as part of linkage 140, a deflecting spring, or the like as will be recognized by one of ordinary skill in the art.

Position sensor 144 can detect the position of linkage 140 relative to elevator 32. In a preferred embodiment, position sensor 144 is an optical sensor, having a light source 146 and a light detector 148. Light from light source 146 illuminates light detector 148 when no cartridge is present or when cartridge 40 is

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a standard tape or cleaning cartridge. When special cartridge 100 is properly seated in elevator 32, linkage 140 blocks light source 146 from illuminating light detector 148. The interaction of linkage 140 and position sensor 144 will be further explained with regards to FIGS. 8A through 8C below.

In a preferred embodiment, leaf spring 150 is used to bias linkage 140 into an unasserted position when no cartridge is seated in elevator 32. Leaf spring 150 has upper leaf 152 and lower leaf 154 contacting linkage 140. In a preferred embodiment, leaf spring 150 is made of steel and is heat staked to the remainder of elevator 32 with plastic stud 156.

Referring now to FIGS. 8A through 8C, sections illustrating the operation of the switch of FIG. 7 are shown. Linkage 140 is comprised of support member 170, first arm 172 extending forward from support member 170, and second arm 174 also extending forward from support member 170. In a preferred embodiment, linkage 140 includes flag 176 to provide a visual indication of the position of linkage 140 and to effectively block light emitted by light source 146 from reaching light detector 148 when flag 176 is between light source 146 and light detector 148. In FIGS. 8A through 8C, light detector 148 is shown as a circle in position sensor 144. Light source 146, cut away in the sectional views, is located so as to generate light which strikes light detector 148 with rays substantially perpendicular to the cut plane.

Support member 170 defines oval slot 178. Axle 142 extends through oval slot 178. Upper spring 152 and lower spring 154 bias support member 170 such

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that, when no cartridge is seated in elevator 32, axle 142 is in the back portion of oval slot, and flag 176 is not blocking light from light source 146 into light detector 148.

5                   Referring now to FIG. 8B, the position of linkage 140 relative to position sensor 144 with standard cartridge 40 seated in elevator 32 is shown. Standard cartridge 40 contacts both first arm 172 and second arm 174, pushing linkage 140 such that axle 142  
10 is substantially in the front of slot 178. Flag 176 is not blocking light from light source 146 into light detector 148.

                  Referring now to FIG. 8C, the position of linkage 140 relative to position sensor 144 with special  
15 cartridge 100 seated in elevator 32 is shown. Special cartridge 100 includes special fencing notch 102. Due to notch 102, first arm 172 does not contact special cartridge 100. However, second arm 174 does contact special cartridge 100. The action of first arm 172 and  
20 second arm 174 cause linkage 140 to rotate about axle 142. Flag 176 then blocks light emitted by light source 146 from reaching light detector 148. Therefore, position sensor 144 is able to detect when special cartridge 100 is seated.

25                   Referring now to FIGS. 9A and 9B, an edge view of an embodiment of the present invention including a write protect tab is shown. Tab 188 is attached to shell 41 in a manner that allows tab 188 to slide along the edge surface of shell 41 containing special file  
30 protect notch 104. FIG. 9A indicates a first position for tab 188 exposing special file protect notch 104. If

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cartridge 100 is inserted into elevator 120 with tab 188 in the first position, control logic associated with elevator 120 will not allow tape in cartridge 100 to be written to. FIG. 9B indicates a second position for tab 188 covering special file protect notch 104. If cartridge 100 is inserted into elevator 120 with tab 188 in the second position, control logic associated with elevator 100 will allow tape in cartridge 100 to be both read from and written to.

Tab 104 may be made of an engineering polymer. Tab 104 may be mounted on rails molded into shell 41, may include arms that slide along slots in shell 41, or the like. Tab 104 and shell 41 may also include means to lock tab 104 in either the first position or the second position unless a minimum force is applied to move tab 104.

While the best modes for carrying out the invention have been described in detail, other possibilities exist within the spirit and scope of the present invention. Those familiar with the art to which this invention relates will recognize various alternative designs and embodiments for practicing the invention as defined by the following claims.

**What Is Claimed Is:**

1. A tape cartridge insertable into a tape deck, the tape deck having an elevator for receiving the cartridge, the cartridge comprising:

5 a shell having an end surface, the end surface having a tape slot from which tape may be drawn;  
a cleaning notch in the end surface;  
a present file protect notch in the end surface,

10 whereby the presence of the cleaning notch and the present file protect notch indicate a standard tape quiescent state to a standard elevator, thereby causing control logic associated with the standard elevator to indicate that no tape is in the standard elevator; and

15 a special fencing notch in the end surface, whereby the presence of the special fencing notch indicates to a special elevator that the cartridge is a special cartridge.

2. The tape cartridge as in claim 1 further  
20 comprising a special file protect notch in the end surface, whereby the presence of the special file protect notch indicates to the special elevator that the cartridge may only be read from.

3. The tape cartridge as in claim 2 further  
25 comprising a tab attached to the edge surface in a manner allowing the tab to slide along the edge surface, the tab positioned so as to cover the special file protect notch when slid into a first position and to expose the special file protect notch when slid into a  
30 second position.



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4. The tape cartridge as in claim 1 wherein the special fencing notch is located so as to further indicate to the special elevator that the cartridge is seated in the special elevator.

5                   5. A tape cartridge having a shell, the shell having a first feature consisting of a cleaning notch in the shell and a second feature consisting of a present file protect notch in the shell, the first and second features together indicating to a standard tape  
10 deck that no tape cartridge is present, the cartridge further comprising:

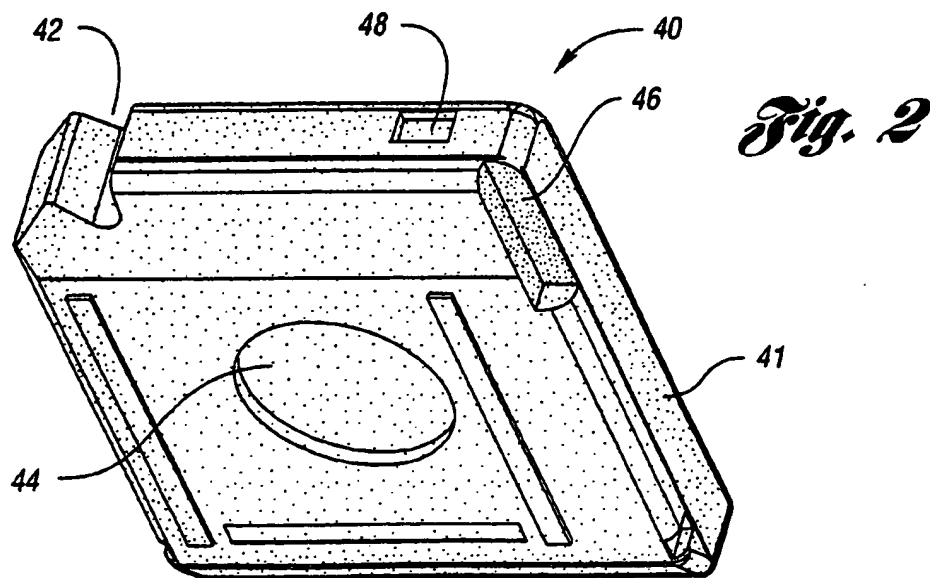
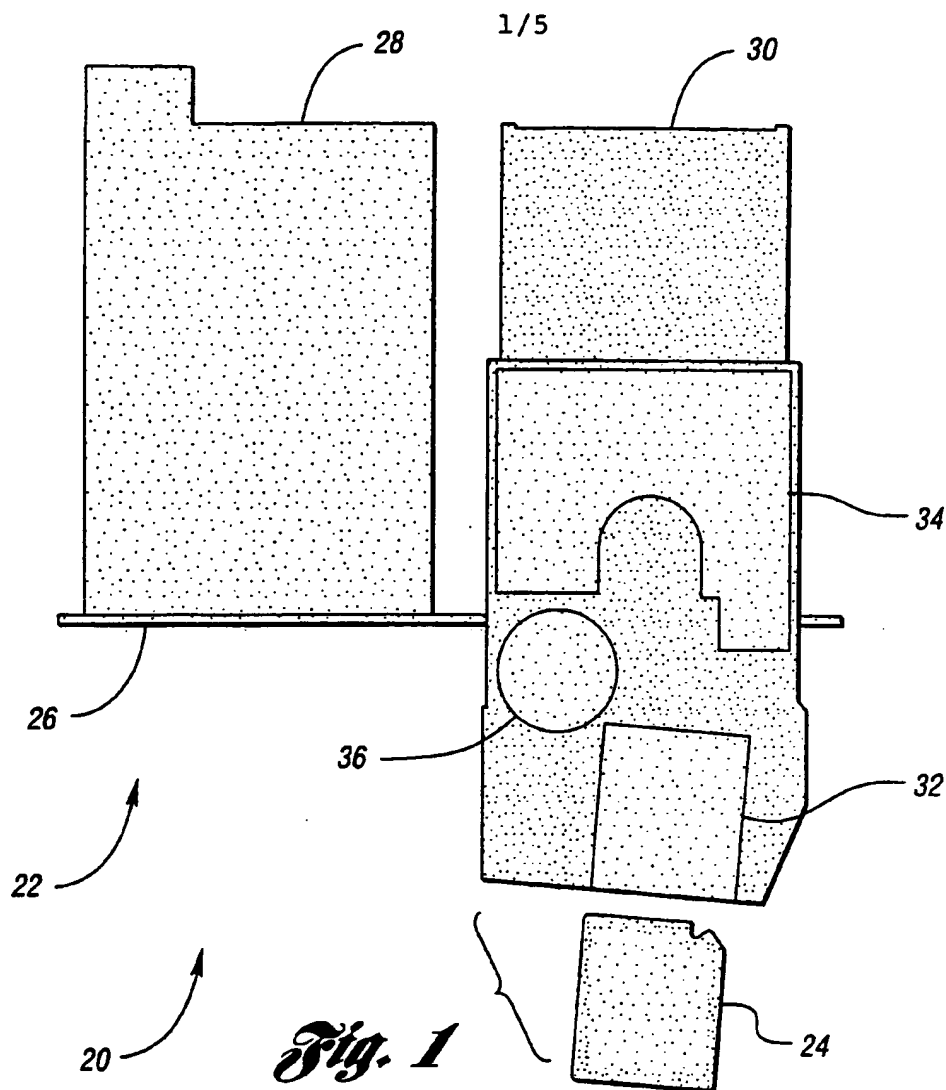
                  a third feature consisting of a special fencing notch indicating to a special tape deck that the cartridge is a special cartridge when the third feature  
15 is present in the shell; and

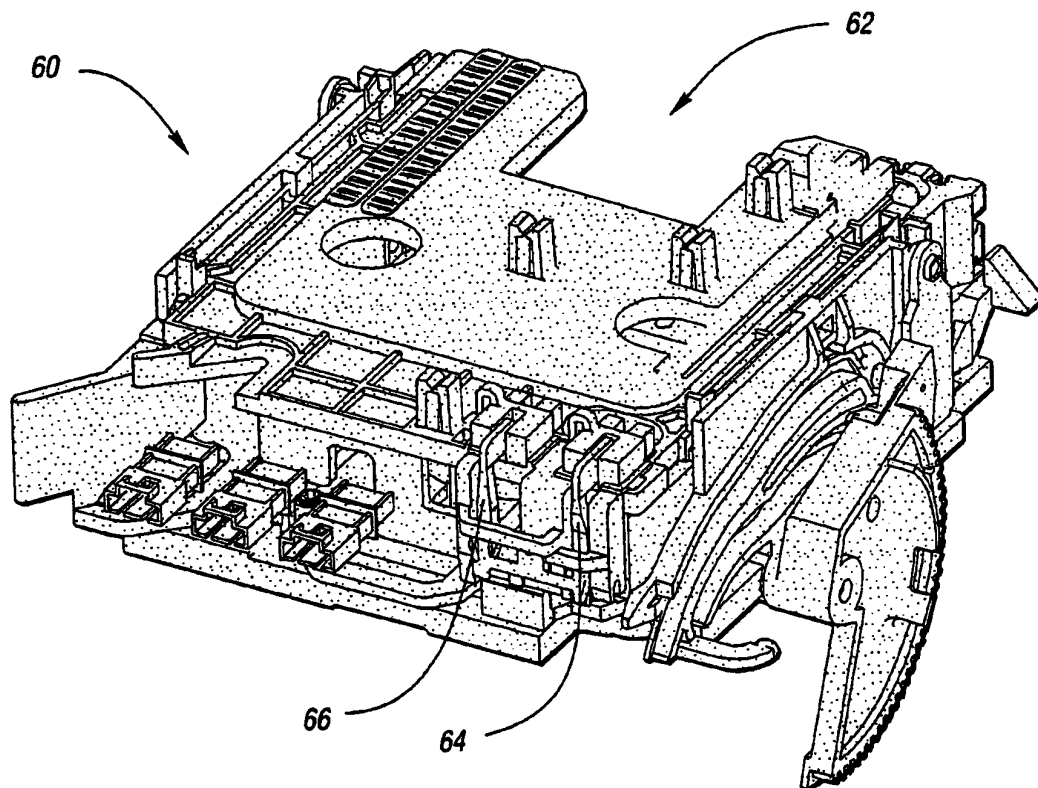
                  a fourth feature consisting of a special file protect notch indicating to the special tape deck that the cartridge is file protected when the fourth feature is present in the shell and indicating that the car-  
20 tridge is writable when the fourth feature is essentially flush with the shell.

6. The tape cartridge as in claim 5 further comprising a tab attached to the shell in a manner allowing the tab to slide along the shell, the tab  
25 positioned so as to expose the special file protect notch when slid into a first position, whereby the fourth feature is present in the shell, and to cover the special file protect notch when slid into a second position, whereby the fourth feature is essentially  
30 flush with the shell.

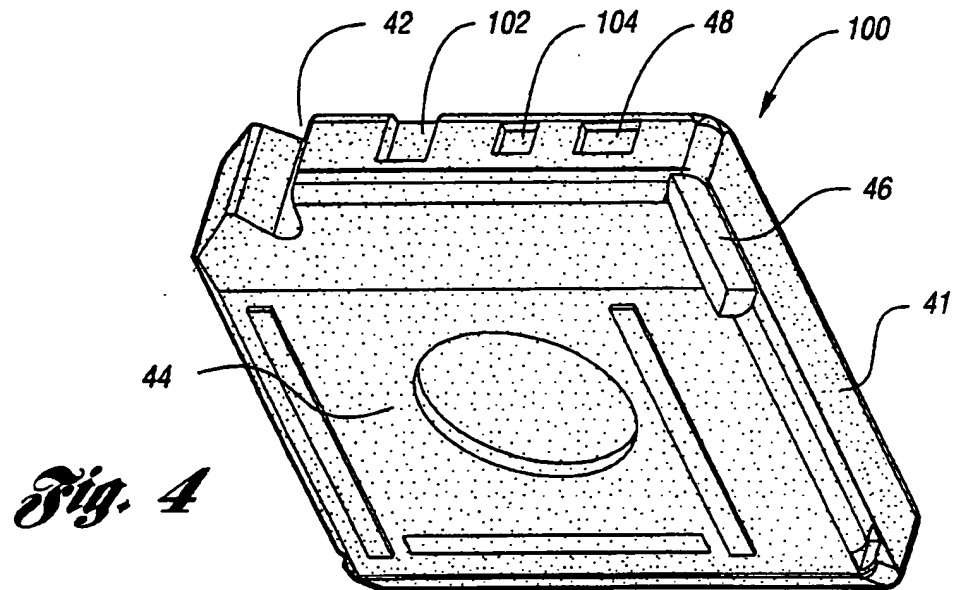
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7. The tape cartridge as in claim 5 wherein the third feature is located so as to further indicate to the special tape deck that the special cartridge is seated in the special tape deck.

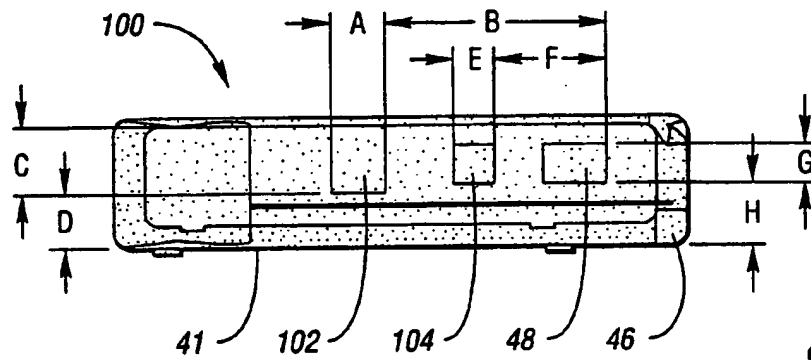




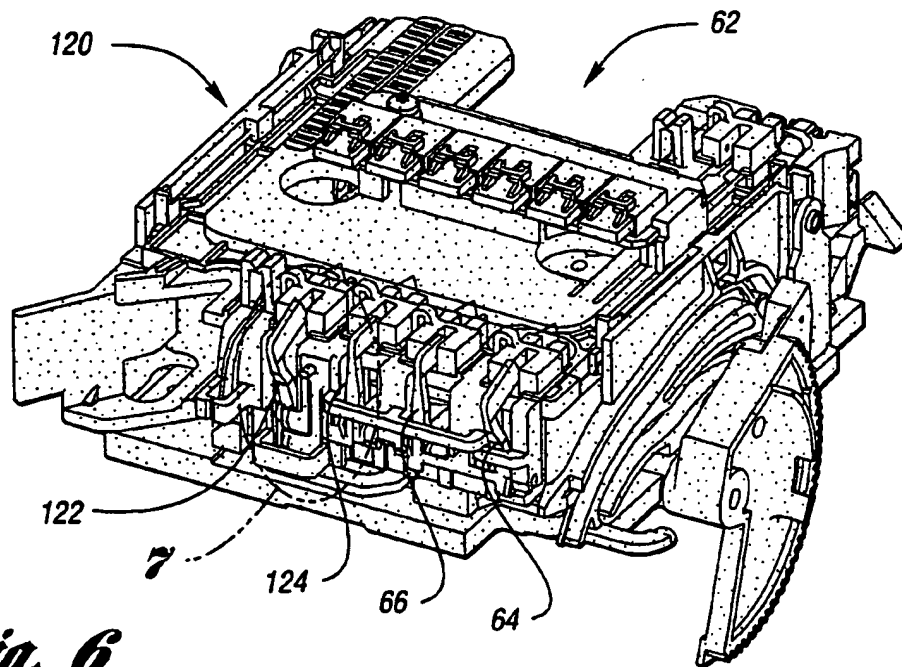
*Fig. 3*



*Fig. 4*

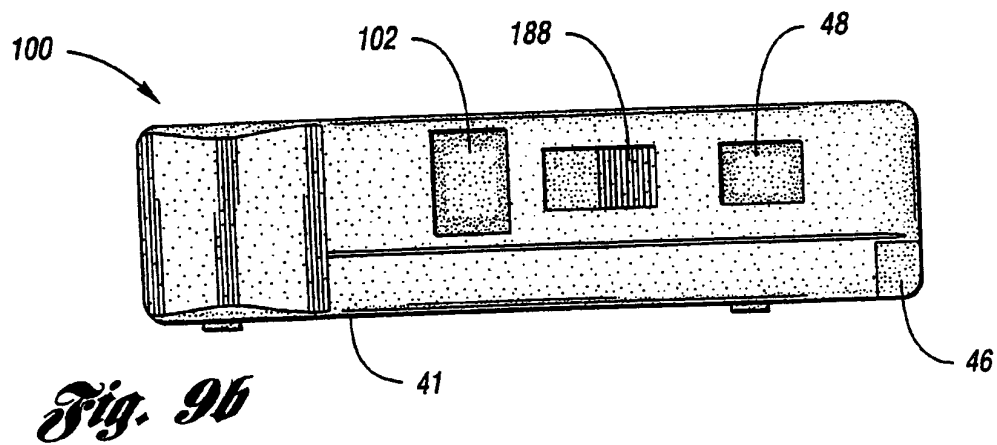
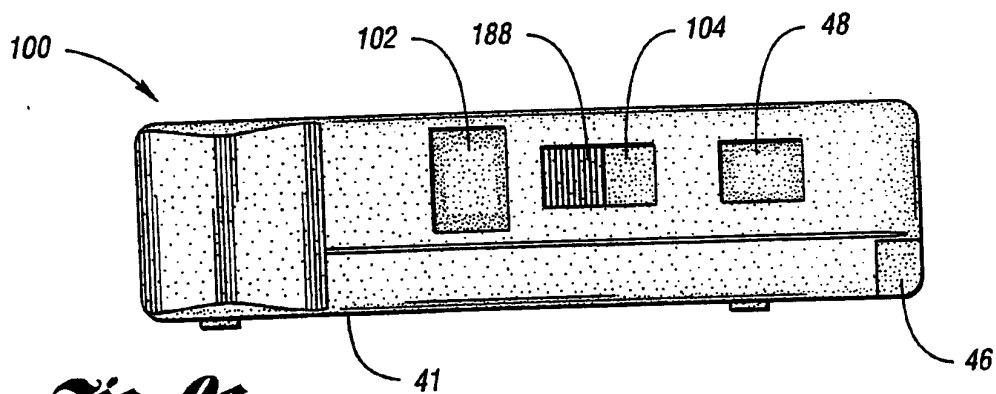
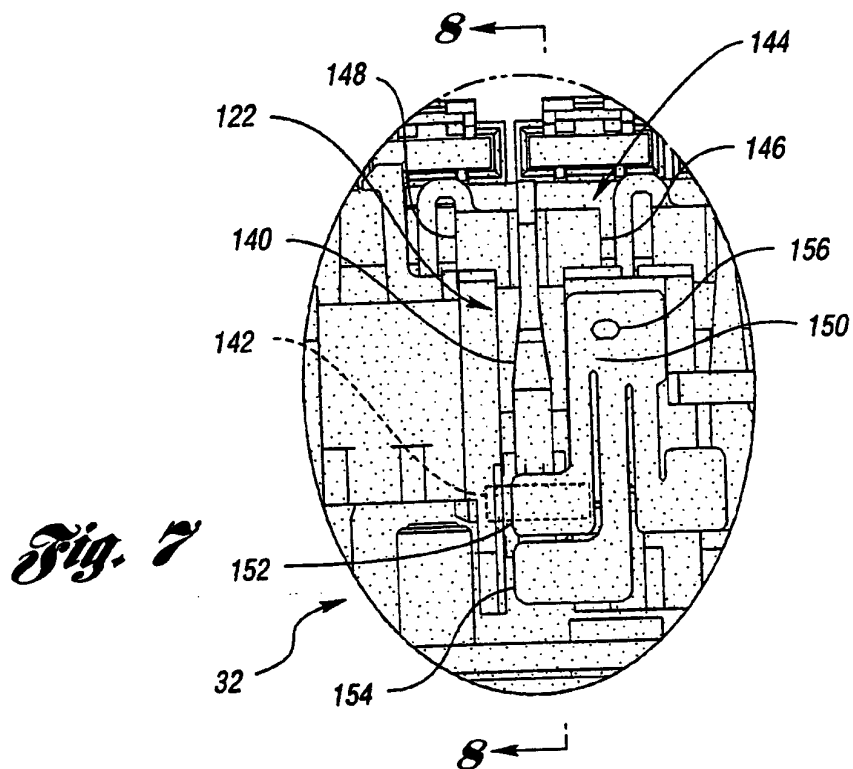


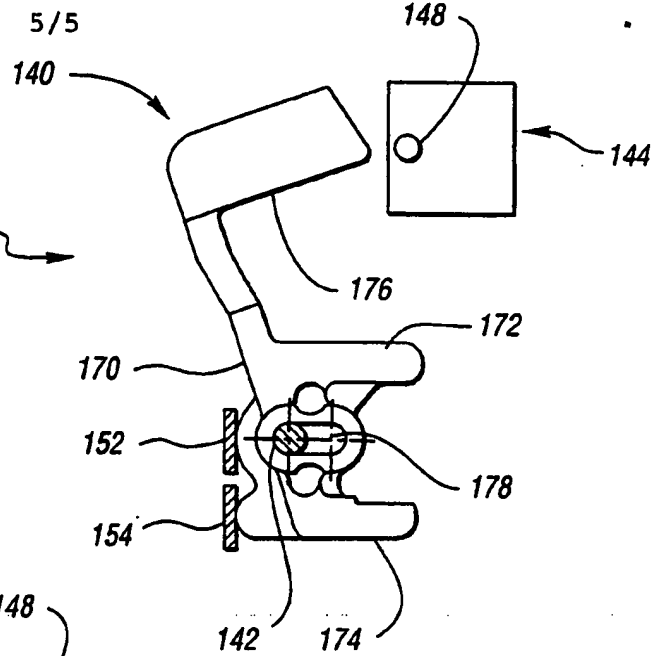
*Fig. 5*



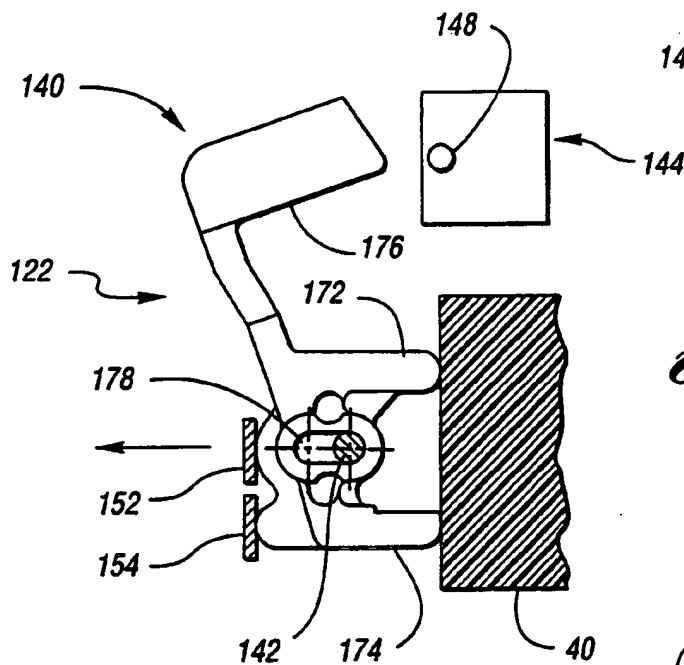
*Fig. 6*

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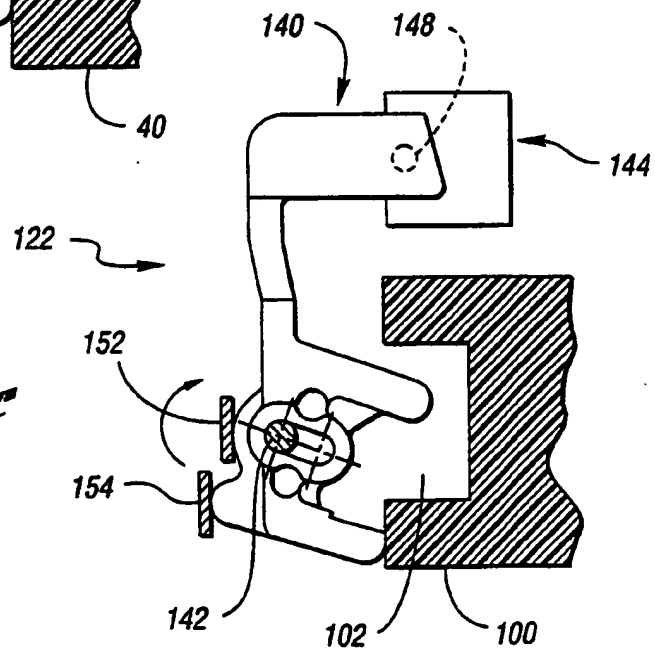




*Fig. 8a*



*Fig. 8b*



*Fig. 8c*

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US99/07553

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G11B 23/027

US CL :360/132

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 360/132, 92; 369/291

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

None

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS, WEST 1.0, GPIC 1.0

search terms: cartridge, tape, notch, elevator, library, cleaning

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5,253,136 A (SUZUKI et al) 12 October 1993, see entire document.	1-7

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*A*	Special categories of cited documents:	*T*	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
*A*	document defining the general state of the art which is not considered to be of particular relevance	*X*	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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